

Six New Species of Tree Ferns from the Andes

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ABSTRACT.—Two new species of *Alsophila* and four of *Cyathea* (Cyatheaceae) are described and illustrated: *Cyathea zongoensis*, *C. arnecornelii* and *C. carolihenrici* from Bolivia; *Alsophila minervae* and *A. mostellaria* from Peru and Bolivia; *Cyathea xenoxyla* from southern Colombia to central Bolivia.

The Family Cyatheaceae shows a pantropical distribution with a clear preference for the moist inner tropics. About 200 species are known from the Neotropics. Unlike Guatemala (Stolze, 1976), Peru (Tryon and Stolze, 1989) or Venezuela (Smith, 1995) no taxonomic treatment of the Cyatheaceae exists yet for Bolivia. In the scope of my master's thesis I conducted a revision of the Bolivian tree ferns (Cyatheaceae and Dicksoniaceae) that involved field studies of most species (Lehnert, 2002). Among the 34 recognized species, six are new to science and are described here. Traveling through Ecuador and Peru in 2002, I had the chance to study many additional specimens of the new species in the herbaria of Quito (QCA, QCNE), Trujillo (HUT), and Lima (USM), and have been able to study the habit of some species for the first time.

A full treatment of the Bolivian tree ferns is in preparation, but several taxonomic and systematic problems, especially among the *Cyathea caracasana-delgadii* alliance, remain to be resolved.

The generic concept for the Cyatheaceae used here follows Lellinger (1987). The main literature consulted included Conant (1983), Gastony (1973), Moran (1991, 1995), Stolze (1984), Tryon (1971, 1972, 1976), and Windisch (1977, 1978).

Alsophila minervae M. Lehnert, *sp. nov.* TYPE.—Bolivia, Dept. La Paz, Prov. Nor Yungas. 2 km de Chuspipata hacia Coroico, 16°22'S 67°94'W, 2900 m, 14 Septiembre 1997, M. Kessler 11900 (holotype: UC; isotypes: GOET, LPB). **Fig. 1 A, B.**

Alsophila indusio globoso, foliis bipinnato-pinnatifidis, sectione apicali gradatim reducta, pinnis apicem versus alatis.

Trunk to 3 m tall and 15 cm in diameter, with squamate spines, without old petiole bases. Fronds to 220 cm long; petiole to 70 cm long, verrucate and with squamate spines, petiole scales to 7×1.4 mm, with dark brown center and broad whitish margins, one apical seta. Petiole scurf consisting of light brown squamellae. Lamina ca. 100 cm wide, bipinnate-pinnatifid to -pinnatisect, its apical section gradually contracted (Fig. 1B). Pinnae and pinnules sessile; distal portions of pinnae slightly green alate. Margins crenulate to serrulate (Fig. 1A).

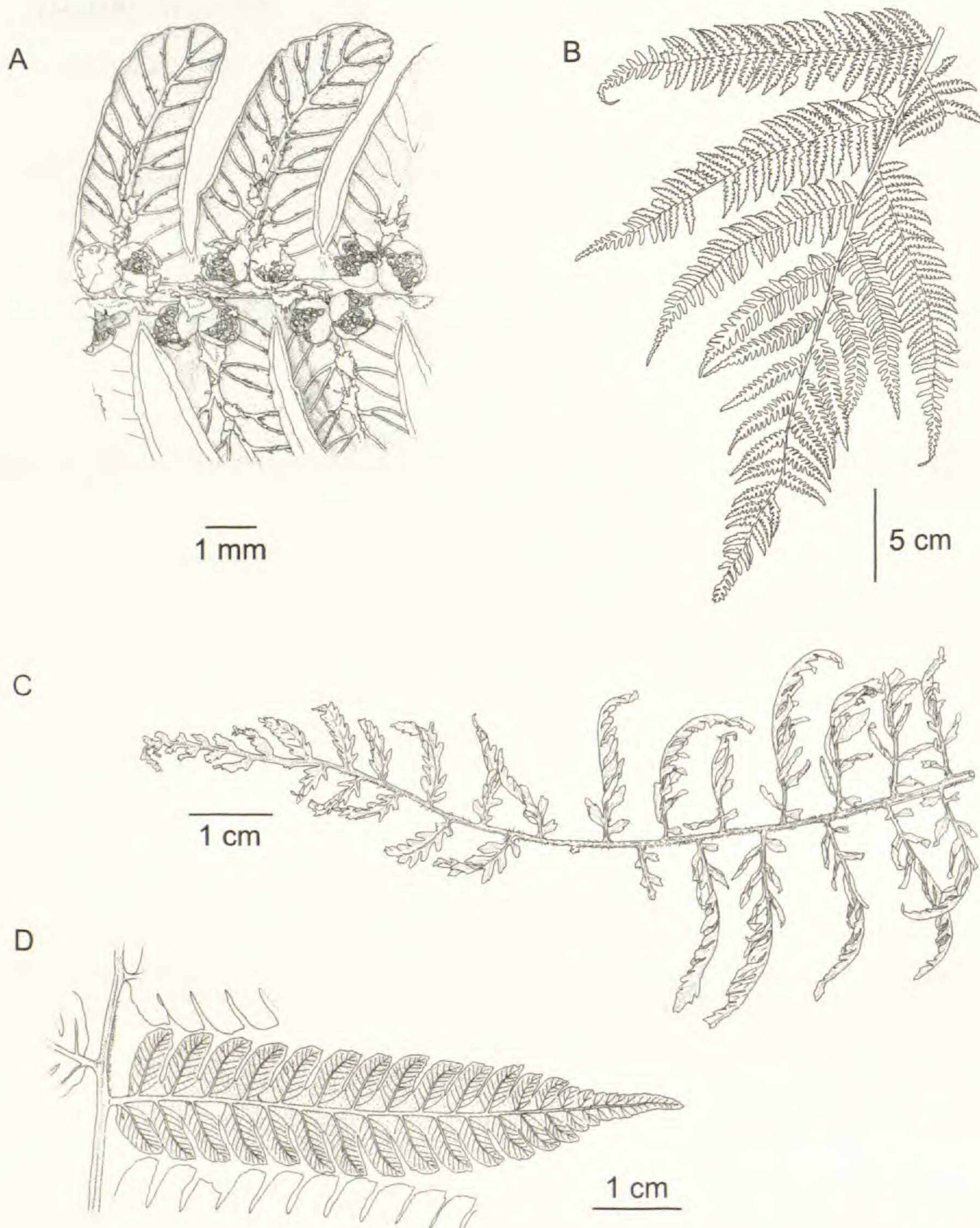


FIG. 1. A, B. *Alsophila minervae* M. Lehnert. A. Pinnule, abaxial side, showing sori, M. Kessler 7015 (GOET). B. Lamina apex, M. Kessler 1190 (UC). C, D. *Alsophila mostellaria* M. Lehnert. C. Subaphlebiate pinna, M. Kessler 11451 (UC). D. Sterile pinnule, abaxially, M. Kessler 11451 (UC).

Costae and costules densely covered with brown hairs on both sides, hairs to 0.5 mm long, additional scurf of brown squamellae and few larger scales abaxially, especially in the junctures of rachis and costae. Leaf axes reddish- to orange-brown. Veins sparsely covered with brown trichomidia, 0.2 mm long; stellate hairs rarely present; with many flattish and bullate squamellae abaxially,

whitish to brown with fringed margins (Fig. 1A). Fertile veins regularly forked except for the basal ones (Fig. 1A). Sori inframedial to costal; indusium cyatheoid to subsphaeopteroid, with irregular dehiscence (Fig. 1A). Paraphyses shorter than sporangia. Spores not examined.

PARATYPES.—**Peru.** Dept. Pasco. Prov. Oxapampa. trail to summit of Cordillera Yanachaga via Río San Daniel, 10°23'S 78°27'W, 2500 m, 17 July 1984, *D.N. Smith, A. & H. Boetger 7817* (USM). **Bolivia.** Dept. La Paz. Prov. Nor Yungas. Carretera Chuspipata – Yolosa, entre Chuspipata y Sacramento Central, 16°17'S 68°48'W, 2700 m, 10 Noviembre 2002, *M. Lehnert 495* (GOET, LPB, UC). Dept. Cochabamba. Prov. Carrasco. 115 km antigua carretera entre Cochabamba y Villa Tunari, 17°08'S 64°38'W, 2500 m, 05 Julio 1996, *M. Kessler 7015* (GOET, LPB, UC).

Alsophila minervae is named after the Roman goddess of wisdom.

Alsophila minervae is sympatric with *A. erinacea* (Karst.) Conant but clearly prefers higher elevations; they are best distinguished by the normally broader petiole scales, well developed indument and distally green alate pinnae of *A. minervae*. The gradually contracted lamina apex (Fig. 1B) clearly separates this new species from all other Andean *Alsophila* species with squaminate spines, which typically have an abruptly reduced apex.

Alsophila minervae grows in the understory of wet montane forest at 2500–2900 m and ranges from central Peru south to central Bolivia.

Alsophila mostellaria M. Lehnert, *sp. nov.* TYPE.—Peru, Dept. Amazonas, Prov. Bongará, Road Pedro Ruiz – Florida, wet quebrada along road side, 05°51.7'S 77°58.4'W, 2200 m, 05 August 2002, *Lehnert 243* (holotype: USM; isotypes: GOET, UC). **Fig. 1 C, D.**

Alsophila basi petioli pinnis subaphlebiatis instructa, petiolis spinulis brevibus squamiformibus obtectis, lamina bipinnato-pinnatifida apicem versus abrupte reducta; soris costae approximatis, indusio sphaeropteroideo usque meniscoideo fatiscente.

Trunk to 6 m high and 9–10 cm in diameter, nearly black, with squaminate spines, completely covered by old spiny petiole bases, appearing sulcate. Fronds to 250 cm long and 110 cm wide. Petioles to 70 cm long, stramineous to orange-brown, proximally nearly black, with short squaminate spines, scurf sparse or absent. Petiole scales long-ovate, 1.6 × 8 mm, discordantly bicolorous with blackish brown center and brown margins, one apical seta. Aphlebioid pinnae in 1–2 pairs basally on the petiole, ca. 10 cm long (Fig. 1C). Rachis stramineous abaxially, brown to black adaxially, with few squaminate spines basally, sparsely hairy adaxially, becoming denser towards the apex, without hairs abaxially; ephemeral scurf sometimes present. Lamina bipinnate-pinnatifid, apical section abruptly reduced, pinnae and pinnules subsessile to short-stalked, margins crenulate or weakly serrate (Fig. 1D). Pinnules to 75 mm long and 19 mm wide. Veins sparsely covered with brown trichomes, 0.6 mm long; no stellate trichomes present. Fertile veins forked. Sori subcostal to

costal; indusium sphaeropteroid in young, fresh material, abraded by the sporangia to a meniscoid shape when mature or dried. Paraphyses as long as the sporangia or shorter. Spores not examined.

PARATYPES.—**Peru.** Dept. Cajamarca. Prov. Santa Cruz. Distrito Catache, upper Río Zaña valley, ca. 5 km above Monte Seco, near base camp clearing, ca. 1800 m, 02–04 May 1987, *M. O. Dillon et al.* 4883 (HUT). Dept. Amazonas. Prov. Bongará. Shillac, N by trail from Pedro Ruiz, 05°49'S 78°01'W, 2300 m, *D.N. Smith & S. Vasquez-S.* 4879 (MO, USM); Road Pedro Ruiz – Florida, wet quebrada along road side, 05°51.7'S 77°58.4'W, 2200 m, 05 August 2002, *M. Lehnert* 241 & 242 (GOET, UC, USM). Dept. Pasco. Prov. Oxapampa. Road La Merced – Oxapampa, ca. 23 km from Oxapampa, 10°44.4'S 75°21.2'W, 1500 m, 27 August 2002, *M. Lehnert* 321 & 322 (GOET, UC, USM); En propiedad del Sr. Espinoza, siguiendo el riachuelo, (ca. 10°44'S ca. 75°21'W, ca. 1800 m), 21 Abril 1988, *B. León & K. Young* 1743 (USM). **Bolivia.** Dept. La Paz, Prov. Caranavi. Serranía Bella Vista, 41 km de Caranavi hacia Sapecho, 15°41'S 67°30'W, 1450 m; 25 Agosto 1997, *M. Kessler* 11451 (GOET, LPB, UC).

This new species is named after the comedy *Mostellaria*, also known as the “ghost comedy”, by the Roman dramaturgian T. Maccius Plautus. *Alsophila mostellaria* also has been a “ghost” because for so long it was known only from a single sterile specimen.

Alsophila mostellaria is unique among Andean tree ferns in having aphlebioid pinnae (Fig. 1C). It differs from the similar aphlebate species *A. setosa* Kaulf. and *A. capensis* (L.f.) J.Sm. in its sphaeropteroid to meniscoid indusium; the other two have hemitelioid indusia. Sterile specimens of *A. capensis* are easily separated by the higher dissection of the aphlebiae (= real aphlebiae), gradually reduced lamina apex, and the absence of squaminate spines on the petiole. *Alsophila setosa* and *A. mostellaria* share aphlebioid pinnae (= aphlebiae of coarse dissection), an abruptly reduced lamina apex, and long squaminate spines. Both species appear to be close allies, and there are no striking differences in sterile material: *A. setosa* may have some lateral seta on the petiole scales and generally has a deeper dissection of the pinnules. These features have not been observed in *A. mostellaria*.

The most similar non-aphlebate species regarding indument and lamina dissection is *Alsophila incana* (Karst.) Conant, which in Bolivia occurs only as far south as the Bolivian – Tucuman region. In Peru, however, both species are sympatric in Prov. Oxapampma, Dept. Pasco. Sterile specimens from this region cannot be told apart if the petiole is missing. In the field, both species are easily distinguished by the trunk which is free of petiole bases and light brown as a result of a thick cover of scales in *A. incana*, whereas *A. mostellaria* is nearly black and covered with old petiole bases.

This species occurs from northern Peru to central Bolivia in wet forests and quebradas at an altitude of 1450–2300 m.

Cyathea zongoensis M. Lehnert, *sp. nov.* TYPE.—Bolivia, Dept. La Paz, Prov. Murillo; Rio Zongo Valley, 22.5 km below dam at Lago Zongo, 16°09'S

68°07'W, 3000 m. Cloud forest, low at 4–8 m tall. Abundant epiphytes, especially liverworts, 09 October 1982, *J.C. Solomon 8429* (holotype: UC; isotype: MO). **Fig. 2.**

Cyathea exindusiata acaulescens simili *C. frigidae* (Karst.) Domin et *C. villosae* Willd., a *C. frigida* paraphysibus longioribus, a *C. villosa* squamis petioli bicoloribus latioribusque differt.

Rhizome creeping or ascending, covered with old petiole bases, ca. 5 cm in diameter, apex hidden. Petioles 60–80 cm long, blackish brown, muricate to tuberculate, scurf absent. Petiole scales to 12 mm long and 5.75 mm wide, long-ovate, pointed, weakly contorted, discordantly bicolorous, brown with yellowish brown margins or yellowish brown with white margins, the center with darker areas (Fig. 2D). Rachis smooth, with dark brown hair adaxially, no hairs abaxially, just a few brown scales. Lamina 50–90 cm long and 70 cm wide, bipinnate-pinnatisect, coriaceous; apex gradually reduced (Fig. 2B). Segment margins deeply crenate to entire, revolute (Fig. 2A). Pinnae sessile to stalked, alternate; pinnules to 16 mm wide and 71 mm long, sessile or very short stalked, deeply pinnatisect, basally truncate, apically obtuse to acute (Fig. 2A). Costa smooth, with many white to light brown hairs adaxially, fewer hairs and some brown scales abaxially. Costules smooth, with many contorted white hairs, additional scales abaxially. Veins on both surfaces with long white hairs, abaxially more so than adaxially (Fig. 2C). Flattish brown scales as well as white bullate ones abaxially. Fertile veins mostly forked (Fig. 2C). Sori inframedial to medial, frequently situated above the furcation; indusium absent. Paraphyses longer than the sporangia, translucent white, contorted over the sorus, easily abraded (Fig. 2C). Spores not examined.

Cyathea zongoensis is named after the type locality, the Zongo valley near La Paz.

This collection was originally determined as *Trichipteris frigida* (Karst.) Tryon (= *Cyathea frigida* (Karst.) Domin) by Barrington. However, *C. frigida* has short paraphyses and fringed scales on the abaxial costules that cover the sori (Karsten 1860, Barrington 1978). In contrast, *C. zongoensis* lacks such scales and the sori are hidden under a veil of paraphyses (Fig 2C). These characters match *C. villosa* Willd. which also occurs in Bolivia but has uniformly reddish-brown, heavily contorted petiole scales (vs. bicolorous, weakly contorted ones (Fig. 2D) in *C. zongoensis*) and grows in different habitats, namely open sunny woods and pastures at 700–1800 m elevation. As recently discovered, young fertile plants of *Cyathea brevistipes* R.C. Moran show the same habit as *C. zongoensis* (Fig. 2B), this species can be distinguished by its sphaeropteroid indusium, and more scales and less hair on the lamina than in *C. zongoensis*.

Known only from one collection from the Rio Zongo valley in the Prov. Murillo, Dept. La Paz, in humid timberline scrub at 3000 m.

The Zongo valley has been visited by numerous botanists, so the lack of collections suggest that this species is genuinely rare. The probability that it is a hybrid should not be excluded; but it seems unlikely as no potential parents grow nearby. The similar, exindusiate *Cyathea frigida* (Karst.) Domin has not

B

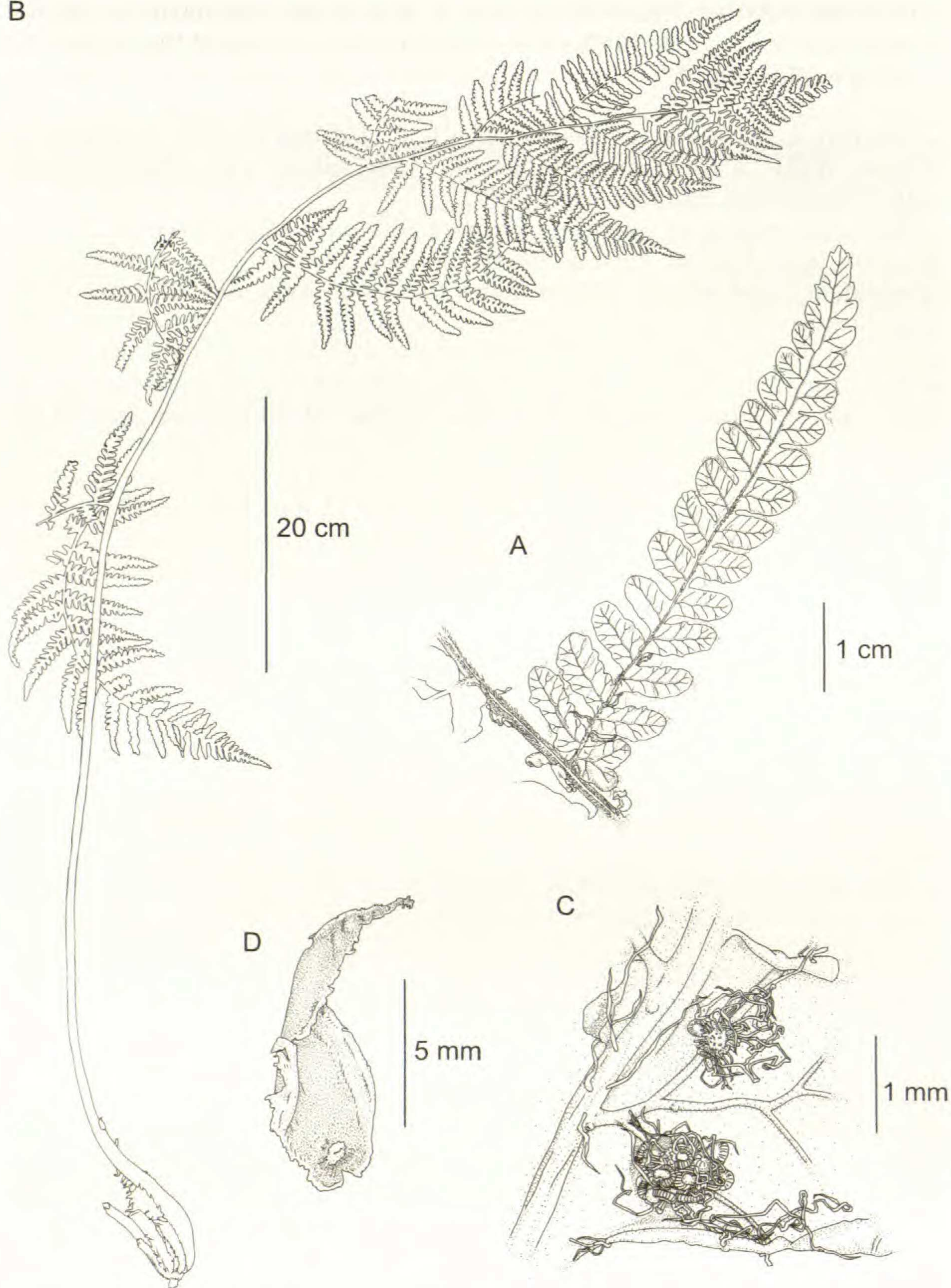


FIG. 2. *Cyathea zongoensis* M. Lehnert. A. Middle pinnule of upper pinna, adaxially, J.C. Solomon 8429 (UC). B. Habit, J.C. Solomon 8429 (UC). C. Sori; upper sori with sporangia removed to show the long paraphyses; upper fertile vein unforked, lower one forked, J.C. Solomon 8429 (UC). D. Petiole scale, J.C. Solomon 8429 (UC).

been reported from Bolivia or the adjacent Peruvian Depts. Puno and Cuzco so far. The equally similar, indusiate *C. brevistipes* R. C. Moran grows at 3000 m near Cotapata some 30 km from the Zongo valley, but hybrids between indusiate and exindusiate *Cyathea* species normally have some remnants of an indusium (Tryon 1976). The highest reaching exindusiate *Cyathea* species in Bolivia, *C. conjugata* (Hook.) Domin, grows in the Zongo valley only below 2500 m. A hybrid between this and any other *Cyathea* species must be suspected to be a much stouter plant than *C. zongoensis*.

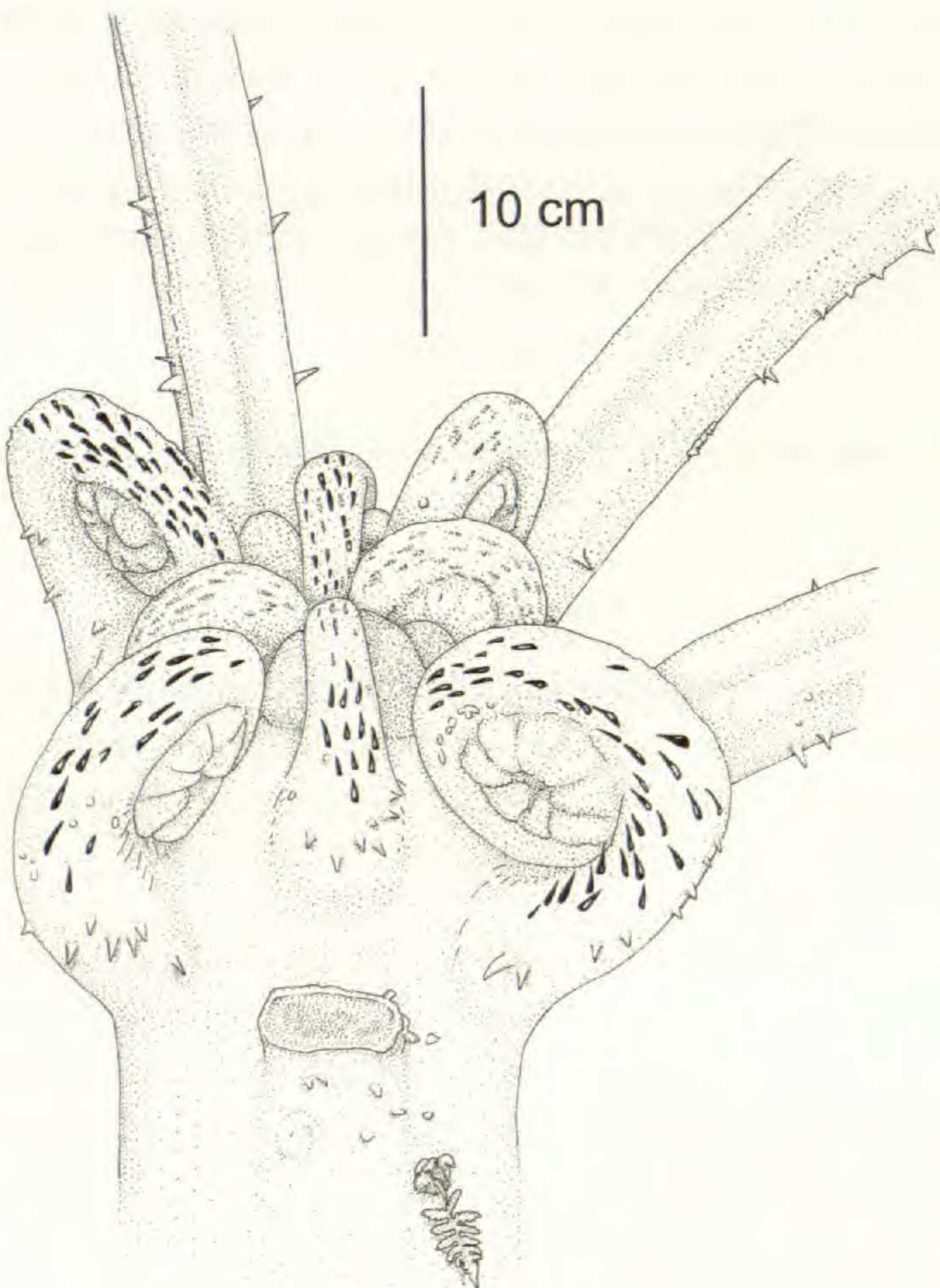
Cyathea xenoxyla M. Lehnert, **sp. nov.** TYPE.—Bolivia, Dept. Cochabamba, Prov. Chaparé, Entre Villa Tunari y Cochabamba, cerca del puente “Rio Carmen May”, 17°10'S 65°44'W, 1950 m, 01 Septiembre 2000, M. Lehnert 049 (holotype: GOET; isotypes: LPB, UC). **Fig. 3.**

Cyathea trunco nudo, non duro, spinulis deficientibus, cicatricibusque foliorum notato. Petioli laevigati spisse indumento isabellino e squamellis minimis luteis brunneisque mixtis obtecti; lamina bipinnato-pinnatifida, glabra vel in pagina inferiore leviter squamulis luteolis castaneisque provisa; indusium cyathiforme margine fragili.

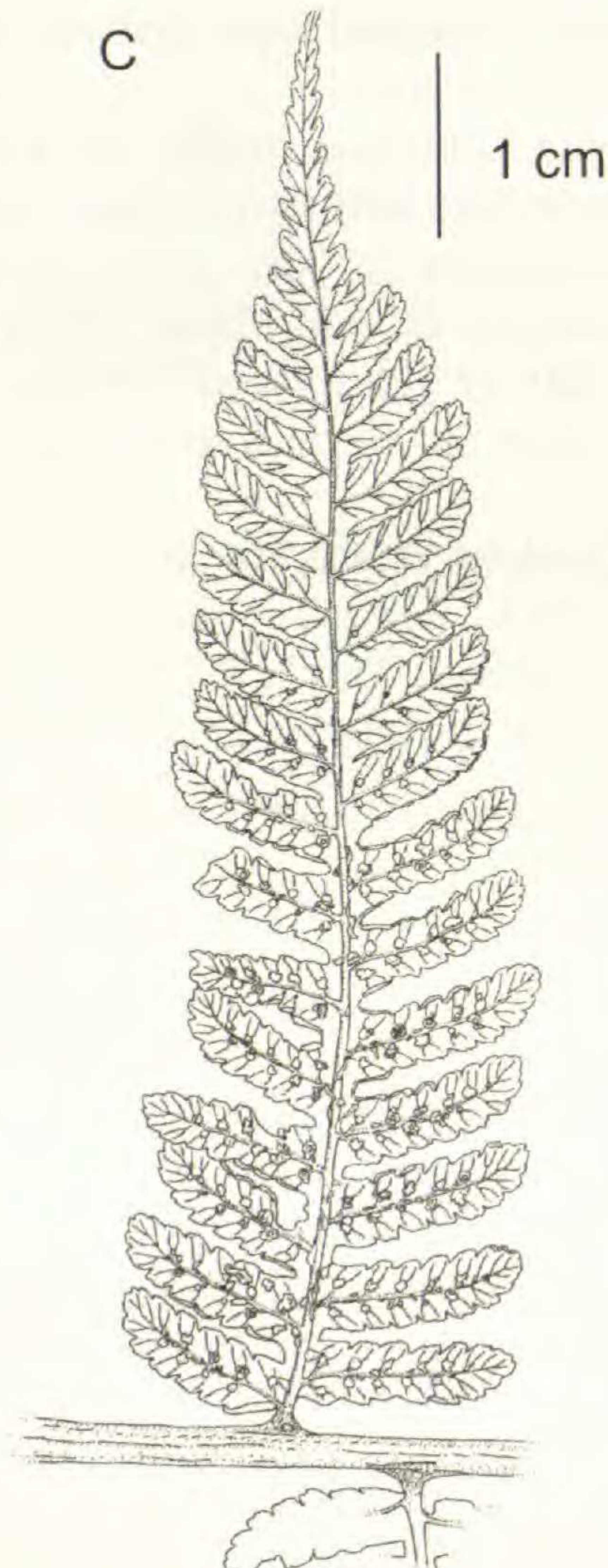
Trunk to 3 m high, 5–10 cm in diameter; soft, inclined or ascending, smooth, lacking spines or old petiole bases, the apex not hidden between petiole bases of green fronds (Fig. 3A). Indument of small squamellae mainly near the apex; when wet easily abraded and giving the trunk a slimy feel. Frond scars oval, conspicuous. Adventitious buds occur regularly (Fig. 3A). Petiole to 110 cm long, without scales when fully grown, with some long corticinate spines (Fig. 3A) and an indument like that of the trunk. Petiole bases with some large pneumathodes of reddish color. Young croziers initially appearing dark castaneous, due to the black scales with light brown margins, later appearing light brown as a result of the visibility of scurf between the scales as the croziers expand (Fig. 3A). Rachis at least basally muricate, slightly hairy adaxially, glabrous abaxially. Lamina 70–120 cm wide and to 120 cm long, mostly bipinnate-pinnatifid to tripinnate, apical section gradually reduced. Pinnae short-stalked, alternate; pinnules sessile, to 22 mm wide and 105 mm long, segment margins crenate to serrate, basally also double serrate (Fig. 3B, C). Costae/costules with swollen junctures (Fig. 3C), hairy adaxially, hairs light brown to brown, glabrous abaxially, scales pale brown, few and scattered. Veins slightly hairy on both sides of the lamina; hairs brown adaxially, light brown to white abaxially. Leaf axes and veins bearing scales abaxially, white bullate ones as well as light brown flattish ones, sometimes with weakly fringed margins (Fig. 3D). Rachis and leaf axes orange-brown to stramineous. Fertile veins forked. Sori subcostal (Fig. 3B); indusium discoid to subsphaeropteroid, easily abraded and then appearing hemitelioid (Fig. 3B). Paraphyses shorter than the sporangia. Spores without perispore, exospore smooth, finely porate.

PARATYPES.—**Colombia.** Prov. Putumayo. Cerro Portachuelo, camino Sibunday á Pepino, 2300 m, 27 Agosto 1965, D.D. Soejarto 1567 (USM). **Ecuador.** Prov. Pichincha. Canton Quito, Río Gualajito Reserve, 10 km W of Chiriboga, km 59

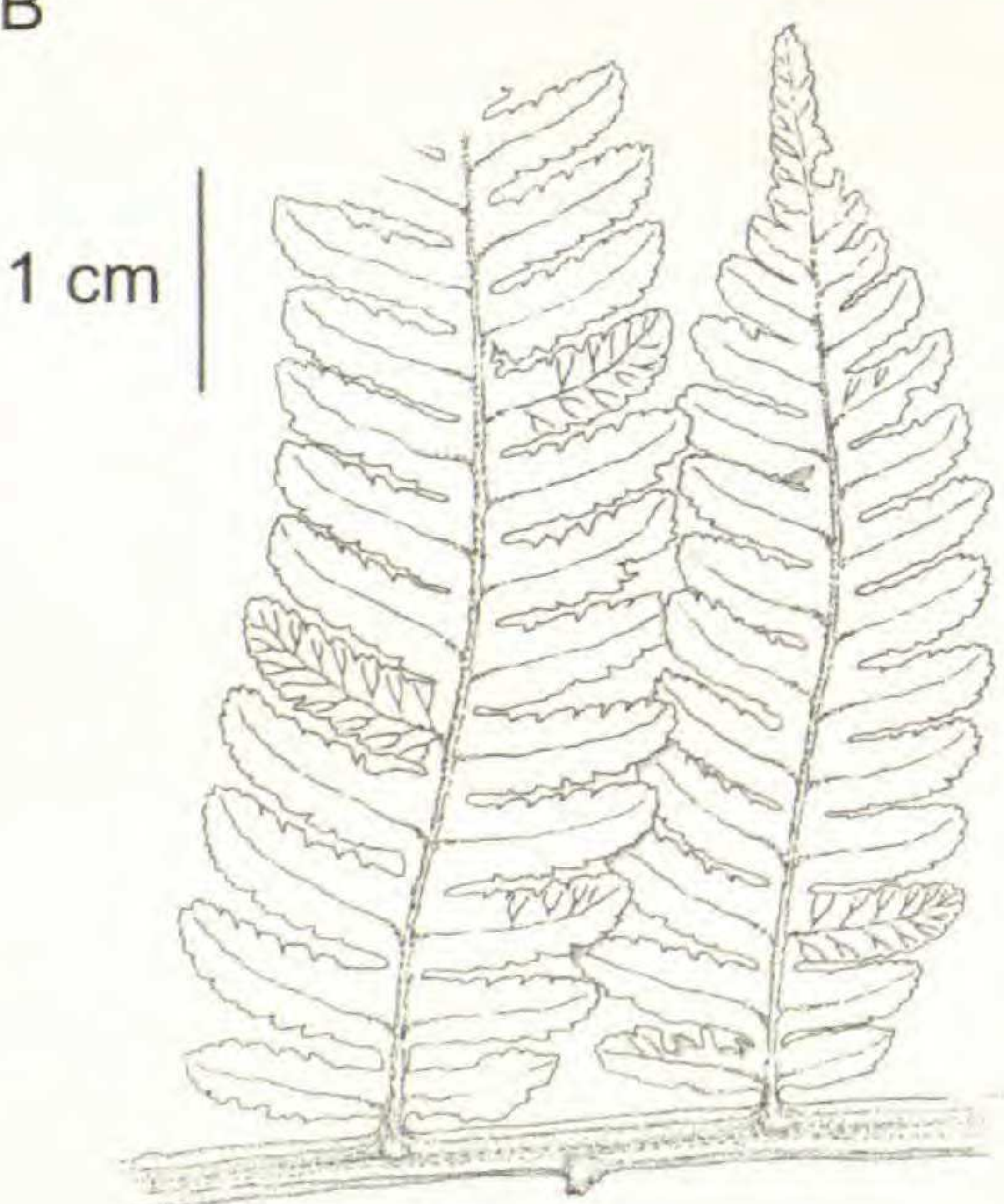
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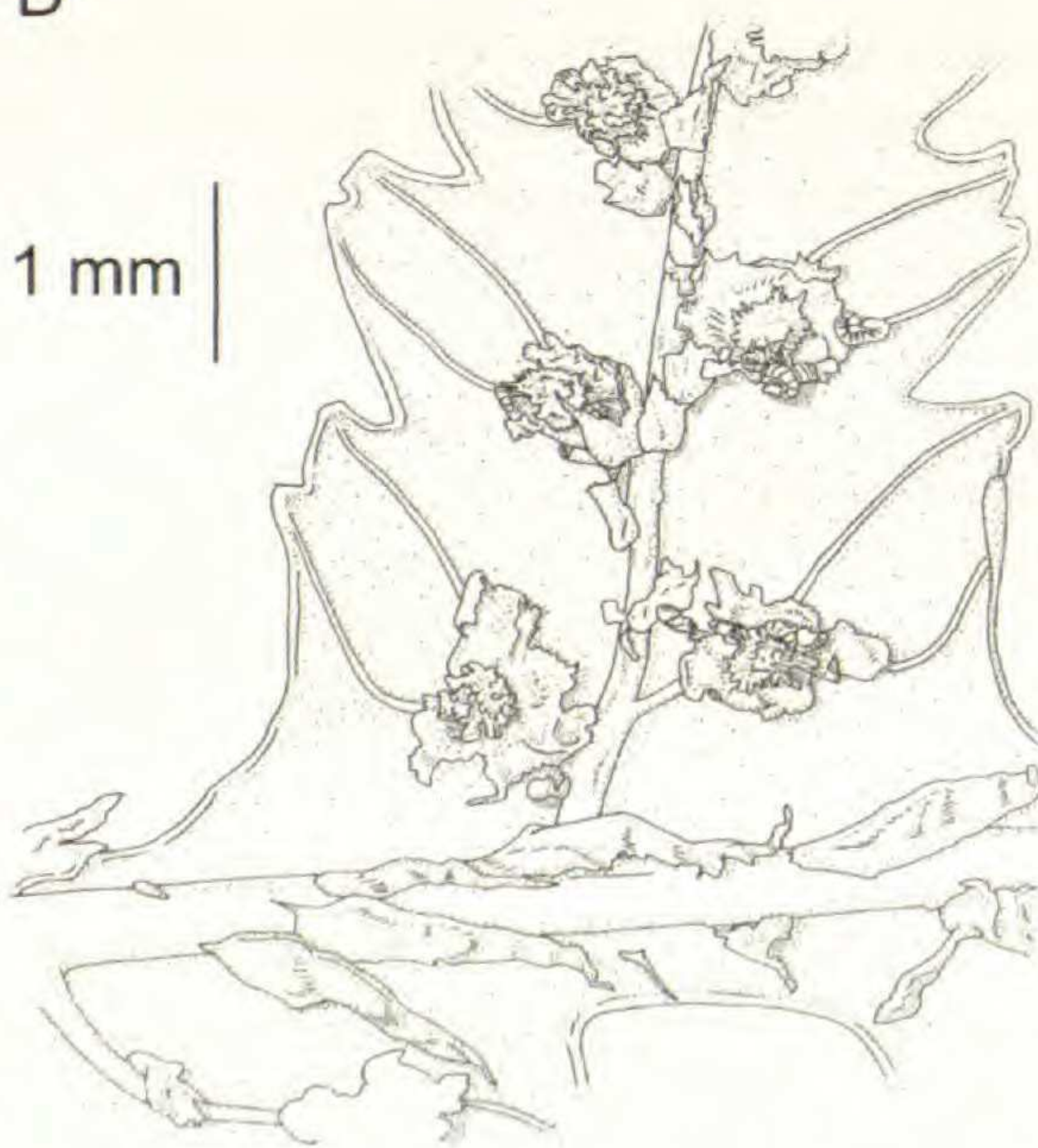
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B



D



of old road Quito – Santo Domingo, 00°14'S 78°48'W, 1900 m, 08 July 1991, A. & L. Fay 3278 (QCA); Canton Quito, Río Gualajito Reserve, 10 km W of Chiriboga, km 59 of old road Quito – Santo Domingo, 00°14'S 78°48'W, 1900 m, 10 July 1991, A. & L. Fay 3356 (QCNE); Estación Científica Río Gualajito, in quebrada Las Palmeras, along road Chiriboga – El Triunfo, 00°14'S 78°47'W, 1800–1900 m, 10 June 1990, B. Øllgaard 98019 (AAU, QCNE). Prov. Pastaza. Road N of Mangayacu, km 1.8 (W of Mera), 01°26'S 78°07'W, 1400 m, 13 November 1994, B. Øllgaard & H. Navarrete, 105650 (AAU, QCNE). Prov. Zamora – Chinchipe. New road Loja – Zamora, 13 km E of the pass, 04°00'S 79°02'W, 2000 m, 14 February 1991, R.C. Moran & C. Rohrbach 5384 (MO, QCNE); Ca. 4 km E of Paquisaca, 03°55'S 78°35'W, 1250 m, 06 February 1989, B. Øllgaard, J.E. Madsen, L. Ellemann & B.J. Eriksen 90438 (AAU, QCNE); Road Loja – Zamora, ca. 13 km E of the pass, just before junction with old road, 03°58'S 79°05'W, 2030 m, 08 March 1989, B. Øllgaard, J.E. Madsen & L. Ellemann 90890 (AAU, QCNE). **Peru.** Dept. Amazonas. Prov. Condorcanqui. Cordillera del Condor, Puerto de la Vigilancia Alfonso Ugarte (PV 3), cabeceras del Río Comainas, tributario al oeste del Río Cenepa; 03°55.0'S 78°25.4'W, 1000–1300 m, 20 Julio 1994, H. Beltran & R. Foster 1083 (USM). Prov. Chachapoyas, Road Chachapoyas – Mendoza, 52 km from Chachapoyas, ca. 10 km behind Molinopampa, 06° 14,2'S 77°35,9'W, 2400 m, 04 August 2002, M. Lehnert 229 (GOET, UC, USM). Dept. San Martín. Prov. Rioja. Road Moyobamba – Pedro Riuz, km 395, trail into forest, 03 August 2002, M. Lehnert 216 (GOET, UC, USM). Dept. Ucayali, Prov. Coronel Portell. Dobson (?), 14 Agosto 1946, R. Ferreyra s.n. (USM). Dept. Pasco, Prov. Oxapampa, Trail to summit of Cordillera Yanachaga via Rio San Daniel, 10°23'S 75°27'W, 2500 m, 17 July 1984, D.N. Smith, H. & A. Boetger 7846 (USM). Dept. Cuzco. Prov. La Convención. Distrito Echaraté, Llactahuaman, N del Río Apurímac, NE del Pueblo Libre, S de la Cordillera de Vilcabamba, 12°51'55.5"S 73°30'40"W, 1650 m, 14 Julio 1998, J. Baldeon, W. Nanray & R. De la Roca 3077 (USM). **Bolivia.** Dept. Cochabamba. Prov. Carrasco. Á 3 km aproximadamente desde del campamento Locotal, en dirección NO, á lo largo de la antigua senda de Kara Huasi á Pojo, 17°46'12"S 64°45'62"W, 2200 m, I. Jimenez 340 (GOET, LPB, UC). Prov. Chapare. 115 km antigua carretera Cochabamba – Villa Tunari, 17°08'S 65°38'W, 2350 m, Bosque siempreverde, cerrado, virgen, 05 Julio 1996, M. Kessler 7007 (GOET, LPB, UC); 130 km antigua carretera Cochabamba – Villa Tunari, 17°07'S 65°36'W, 2000 m, Bosque siempreverde, cerrado, virgen, 13 Julio 1996, M. Kessler 7220 (GOET, LPB, UC).

This species is named for its peculiar soft trunk (Greek ξέφος = strange, τὸ ξύλον = wood).

The spiny petiole with its dense scurf and lack of scales (Fig. 3A) makes it possible to identify this species even when lamina samples are poor

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FIG. 3. *Cyathea xenoxyla* M. Lehnert. A. Trunk apex with croziers and adventitious bud below cut-off petiole, photo M. Lehnert 049. B. Pinnules, adaxially, M. Lehnert 049 (GOET). C. Pinnule with sori, abaxially, M. Lehnert 049 (GOET). D. Sori, M. Kessler 7220 (UC).

(*R. Ferreyra s.n.*, USM). This character combination is not present in species with similar lamina dissection like *C. amazonica* R.C. Moran and *C. multiflora* J.Sm., or in *C. pallescens* (Sod.) Domin which has similar scales on the abaxial lamina surface. The naked fleshy trunk (Fig. 3A) is the best field characteristic of *C. xenoxyla*. This distinctive species is perhaps related to *Cyathea mucilagina* R.C. Moran from Costa Rica and Peru, which also grows in very moist woods and seems to have a similar habit, but that species lacks indusia, has persistent petiole scales, and has abaxially winged costules.

This is a locally common tree fern in the undergrowth of mature humid montane forests at 1000–2500 m elevation; it evidently prefers moist to swampy soils. Among the new *Cyathea* species described here, this is the only one with a fairly wide range, reaching from central Bolivia to southern Colombia and possibly farther north.

Cyathea arnecornelii M. Lehnert, *sp. nov.* TYPE.—Bolivia. Dept. La Paz, Prov. Nor Yungas; Chuspipata á Yolosa, km 7; 16°17'S 67°48'W, 2700 m, Bosque secundario, 01 Agosto 2000, *M. Lehnert 003* (holotype: GOET; isotypes: LPB, UC). **Fig. 4.**

Cyathea trunco duro, cicatricibus foliorum notato, apice dense squamulis brunneis cinereo-marginatis obtecto. Juncturae costarum cum rhachidi costulisque aerophoros ferentes. Differt a *C. caracasana* (Klotzsch) Domin indusio hemitelioido, a *C. multiflora* J.Sm. indusio squamulis in receptaculo insertis obtecto.

Trunk to 3–4 m high, 7–12 cm in diameter; smooth, no spines or old petiole bases, apex not hidden between the petiole bases of the green fronds, stem scales mostly deciduous, present only at the apex; apex often broader than the trunk due to densely arranged croziers (Fig. 4A), these covered with deciduous scales; outward on the young croziers scales dark brown to almost black with broad grey margin, inwards more and more the color of the margins prevailing, ending in uniformly gray scales (Fig. 4B). Petiole 50 cm long, smooth to slightly verrucate, without indument (Fig. 4A, B) except for some persistent crozier scales. Rachis smooth, hairy adaxially, glabrous abaxially. Lamina 150 cm long and 50–80 cm wide, coriaceous, bipinnate-pinnatifid to tripinnate, the apical section gradually reduced. Pinnae stalked, alternate; pinnules sessile, to 21 mm wide and 65 mm long. Segments obtuse to rounded, margins crenate to serrate (Fig. 4C). Costae/costules smooth, normally with prominent aerophores at their bases (Fig. 4C); moderately to densely covered with light brown hairs adaxially; with many trichomidia and squamules abaxially, but only costules with few trichomes. Veins glabrous or with occasional white hairs on both sides, squamules white to light brown, flattish and bullate; no hairs between the veins. Fertile veins forked. Sori subcostal; indusium hemitelioid, small and ascending, normally covered by scales inserted at the receptacle (Fig. 4C). Paraphyses shorter than the sporangia. Spores not examined.

PARATYPES.—**Bolivia.** Dept. La Paz. Prov. Nor Yungas. 2 km de Chuspipata hacia Coroico, 16°22'S 67°49'W, 2900 m, Bosque secundario; 14 Septiembre

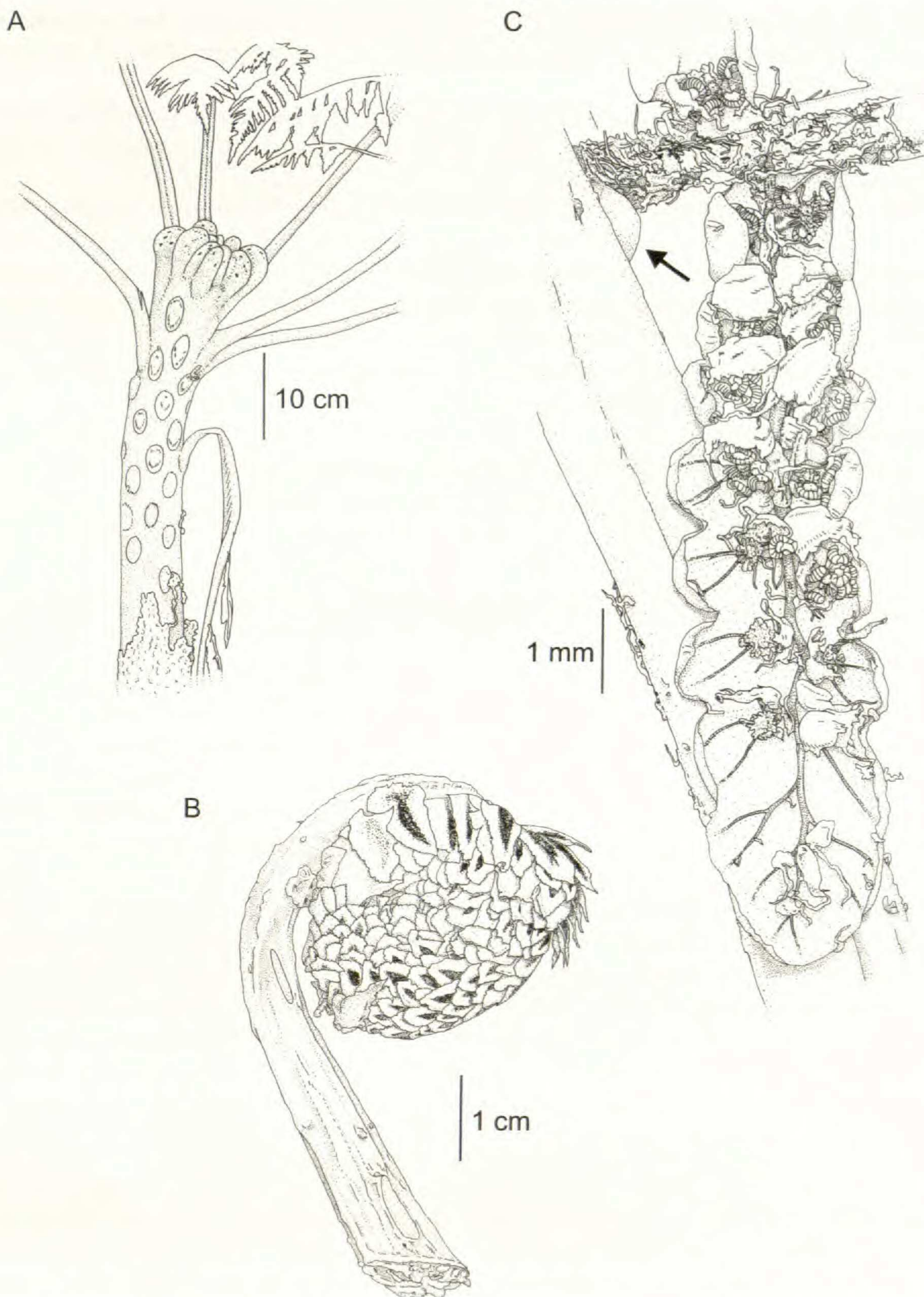


FIG. 4. *Cyathea arnecornelii* M. Lehnert. A. Trunk, photo M. Lehnert 003. B. Crozier, M. Lehnert 003 (GOET). C. Lower segment of fertile pinnule; lower ones missing additional scale on receptacle; hemitelioid indusium; arrow indicating small aerophore, M. Lehnert 003 (GOET).

1997, *M. Kessler 11905* (GOET, LPB, UC); 5 km de Chuspipata hacia Coroico, 16°23'S 67°48'W, 2800 m, Bosque secundario; 19 Septiembre 1997, *M. Kessler 12092* (GOET, LPB, UC).

I name this species in memory of the biology student Arne Cornelius from Göttingen University, Germany, who died under tragic circumstances while conducting field work in Borneo.

The smooth, scale-free petiole (Fig. 4A, B) as well as the aerophores (Fig. 4C) are the most significant features of sterile material of this species; similar species like *C. caracasana* (Klotzsch) Domin or *C. delgadii* Sternb., which sometimes have a swollen juncture of costae and costules, have different scale coloration and rarely truly inermous petioles. In the field, the broad trunk apex is most remarkable. Fertile material of *C. arnecornelii* is easily recognized by the combination of hemitelioid indusium and additional scales on the receptacle (Fig. 4C).

Known from humid montane forest, disturbed secondary forests, and even along roads, at 2700–2900 m elevation, only near Chuspipata (Dept. La Paz, Prov. Nor Yungas, Bolivia).

Cyathea carolihenrici M. Lehnert, *sp. nov.* TYPE.—Bolivia. Dept. La Paz, Prov. Nor Yungas, Cotapata Santa Barbara, 16°18'S 67°52'W, 3150 m, Bosque nublado, 06 Agosto 2000, *M. Lehnert 011* (holotype: GOET; isotypes: LPB, UC). **Fig. 5.**

Cyathea indusio globoso, trunco squamulis fusco-brunneis oblecto; lamina bipinnato-pinnatifida usque tripinnata, glabra vel inferiore squamulis castaneis minutis fimbriatisque vestita. Differt a *Cyathea caracasana* (Klotzsch) Domin colore squamularum, a *C. pallescenti* (Sod.) Domin lamina in pagina superiori glabra.

Trunk to 7 m tall and 10–15 cm in diameter; small plants (160 cm tall, *M. Lehnert 011*) with persistent old spiny petiole bases, apex hidden among petiole bases of the green fronds; trunk of larger plants unknown. Petiole 100 cm long, verrucate to aculeate; petiole scales discordantly bicolorous, variable, either golden brown with dark central stripe or brown with broad white margin (Fig. 5C). Petiole scurf consisting of brown trichomidia and squamellae. Rachis smooth or with scattered small corticinate spines, hairs absent, scurf of minute fringed brown squamellae. Lamina ca. 150 cm long and 130–140 cm wide, bipinnate-pinnatifid to tripinnate (Fig. 5A), apical section gradually contracted, coriaceous. Pinnae long stalked; pinnules short to long stalked, to 40 mm wide and 130 mm long (Fig. 5A). Segments rounded, margins revolute, slightly crenulate to entire (Fig. 5B). Costae smooth to muricate, costules smooth; costae and costules densely covered with brown hairs adaxially, with fewer or no hairs and additional scurf of minute brown squamellae abaxially (Fig. 5A, D). Leaf axes dark brown, in strong contrast to the lamina. Veins sparsely covered with brown hairs adaxially, few hairs and many squamellae like those on the costulae abaxially (Fig. 5D). Fertile veins forked (Fig. 5A, D). Sori subcostal; indusium subsphaeropteroid, dark brown and persistent,

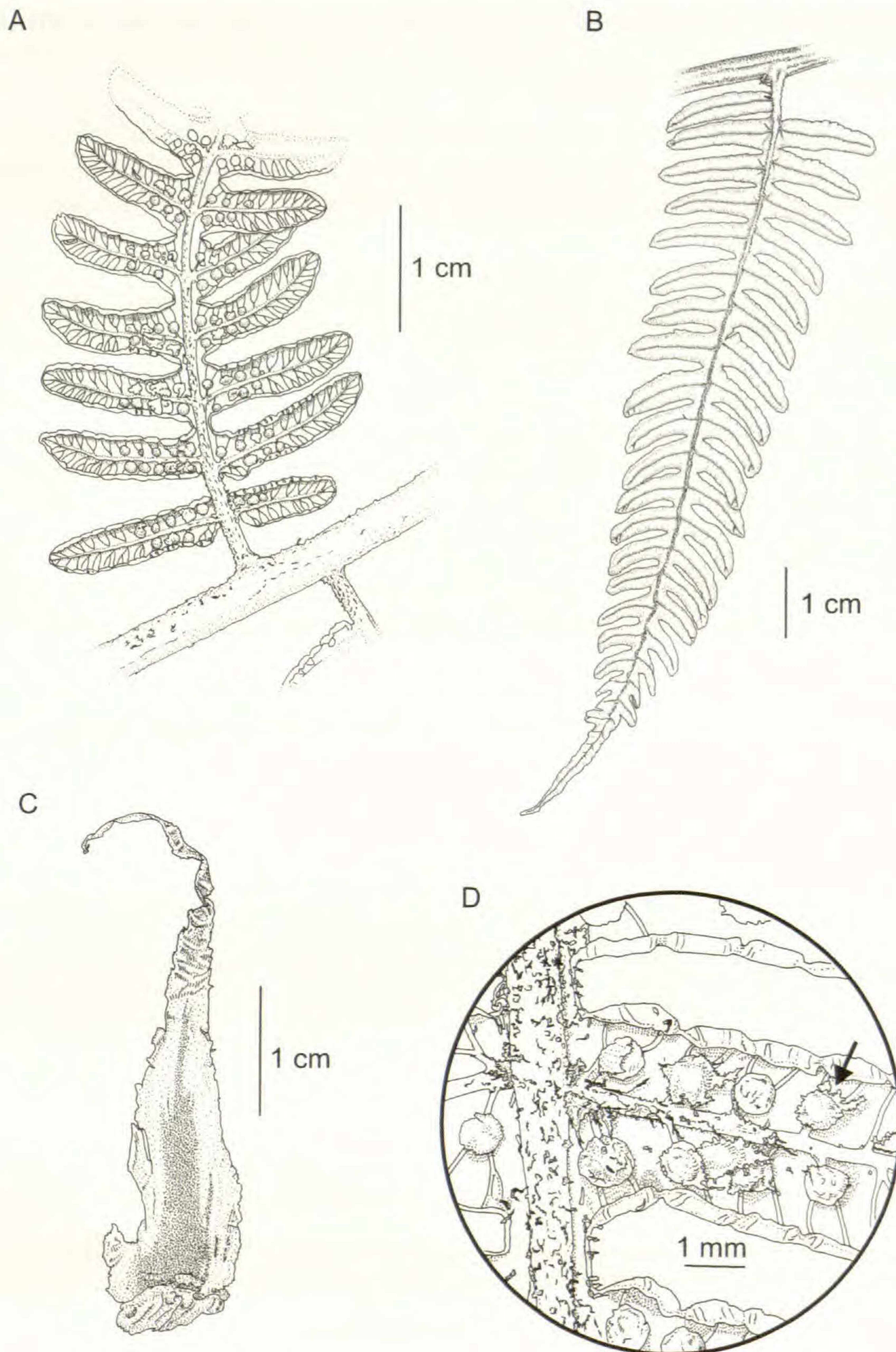


FIG. 5. *Cyathea carolihenrici* M. Lehnert. A. Fertile pinnule abaxially, *M. Lehnert 011* (GOET). B. Pinnule adaxially, *M. Lehnert 011* (GOET). C. Petiole scale, *M. Lehnert 011* (GOET). D. Sori; typical squamules on costule and mid vein of segment; arrow indicating squamule arising from indusium, *M. Lehnert 011* (GOET).

without umbo, sometimes with small scale arising from the indusium (Fig. 5D). Paraphyses as long as the sporangia or a bit longer. Spores with verrucate exospore and baculate perispore.

PARATYPE.—**Bolivia.** Dept. La Paz. Prov. Nor Yungas. Trocha al Valle de Coscapa, Parque Nacional de Cotapata, 16°12'S 67°53'W, 3000 m, Bosque siempreverde, virgen de 15 m de altura, 12 Septiembre 1997, *M. Kessler 11875* (GOET, LPB, UC).

I name this species after my grandfather Karl-Heinz Hass.

Cyathea carolihenrici is a typical elfin forest tree fern; the coriaceous lamina and the sphaeropteroid indusium (Fig. 5D) are features shared by many other species in this habitat. It is most similar to *C. pallescens* (Sod.) Domin from which it differs in its glabrous upper lamina surface (Fig. 5B); both share a firm indusium and discordantly bicolorous petiole scales (Fig. 5C). Other similar species with a persistent indusium have a stronger contrast in the petiole scale colors than *C. carolihenrici*: *C. boliviana* R.M. Tryon has a white, broad petiole scale margin with occasional dark cell groups, *C. straminea* Karst. has almost entirely white scales. *Cyathea caracasana* (Klotzsch) Domin has an ephemeral indusium and concordantly bicolorous petiole scales. *Cyathea carolihenrici* is unique in its indument of minute, castaneous scales on the abaxial leaf axes (Fig. 5D).

Cyathea carolihenrici grows at 3000–3150 m in very humid elfin forests near Unduavi and the nearby Cotapata National Park in the Prov. Nor Yungas, Dept. La Paz.

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